# RECORDING MEDIUM HAVING DATA STRUCTURE FOR MANAGING REPRODUCTION OF STILL IMAGES RECORDED THEREON AND RECORDING AND REPRODUCING METHODS AND APPARATUSES

## FOREIGN PRIORITY

[0001]    The present invention claims priority under 35 U.S.C. 119 on Korean Application No. 2002-53858 filed September 6, 2002 and

5  Korean Application No. 2002-53830 filed September 6, 2002; the contents of each above-cited Korean applications are incorporated by reference in their entirety.

## BACKGROUND OF THE INVENTION

### Field of the Invention

[0002]    The present invention relates to a recording medium

10  having a data structure for managing reproduction of at least still images recorded thereon as well as methods and apparatuses for reproduction and recording.

### Description of the Related Art

[0003]    The standardization of new high-density read only and rewritable optical disks capable of recording large amounts of high-quality

15  video and audio data has been progressing rapidly and new optical disk related products are expected to be commercially available on the market in the near future. The Blu-ray Disc Rewritable (BD-RE) and Blu-ray Disk ROM

(BD-ROM) are examples of these new optical disks.

[0004]     The standardization for high-density read-only optical disks such as the Blu-ray ROM (BD-ROM) is still under way. An effective data structure for managing reproduction of still images recorded on the

5   high-density read-only optical disk such as a BD-ROM is not yet available.

## SUMMARY OF THE INVENTION

[0005]     The recording medium according to the present invention includes a data structure for managing reproduction of at least still images recorded on the recording medium.

[0006]     In one exemplary embodiment, an information file area of

10   the recording medium includes at least one information file. The information file is associated with a data file recorded on the recording medium, and the data file includes at least video data. The information file includes a type indicator indicating whether the video data in the data file is for at least one still image.

15          [0007]     In another exemplary embodiment, a data area stores the data file, and the data file includes video data representing at least one still image. Here, each still image in the data file is recorded as a packetized elementary stream packet.

[0008]     In yet another exemplary embodiment, a data area stores

20   the data file, the data file includes video data representing at least one still image, and the video data in the data file is recorded as one or more

packetized elementary stream packets. In this embodiment, only one still image is represented by each packetized elementary stream packet in the data file.

[0009]     The present invention further provides apparatuses and methods for recording and reproducing the data structure according to the present invention.

## BRIEF DESCRIPTION OF THE DRAWINGS

[0010]     The above features and other advantages of the present invention will be more clearly understood from the following detailed description taken in conjunction with the accompanying drawings, in which:

[0011]     Fig. 1 illustrates an exemplary embodiment of a recording medium file or data structure according to the present invention;

[0012]     Fig. 2 illustrates an example of a recording medium having the data structure of Fig. 1 stored thereon;

[0013]     Fig. 3 illustrates a method of managing still images for a high-density recording medium in accordance with one embodiment of the invention;

[0014]     Figs. 4–7 illustrate further methods of recording and managing still image and still information files according to embodiments of the present invention;

[0015]     Figs. 8–11 illustrate further embodiments of file structures for a high-density recording medium according to the present

invention;

**[0016]**   Figs. 12–17 illustrate methods of recording still images and still information in accordance with additional embodiments of the present invention;

5    **[0017]**   Fig. 18 illustrates a schematic diagram of an embodiment of an optical disk recording and reproduction apparatus of the present invention; and

**[0018]**   Figs. 19 and 20 illustrate methods of playback of still images for a high-density recording medium in accordance with

10   embodiments of the invention.


## DESCRIPTION OF THE PREFERRED EMBODIMENTS

**[0019]**   In order that the invention may be fully understood, exemplary embodiments thereof will now be described with reference to the accompanying drawings.

**[0020]**   A high-density optical disk, for example, a Blu-Ray ROM

15   (BD-ROM), BD-RE, etc. in accordance with the invention may have a file or data structure for managing reproduction of video and audio data as shown in Fig. 1.  Some aspects of the data structure according to the present invention shown in Fig. 1 are the same as the well-known BD-RE standard, as such these aspects will not be described in great detail.

20    **[0021]**   As shown in Fig. 1, the root directory contains at least one BD directory.  The BD directory includes general files (not shown), a

PLAYLIST directory in which playlist files (e.g., *.mpls) are stored, a CLIPINF directory in which clip information files (*.clpi) are stored, and a STREAM directory in which MPEG2-formatted A/V stream clip files (*.m2ts), corresponding to the clip information files, are stored.

5      **[0022]**      The STREAM directory includes MPEG2-formatted A/V stream files called clips or clip files. The A/V stream includes source packets of video and audio data. For example, a source packet of video data includes a header and a transport packet. A source packet includes a source packet number, which is generally a sequentially assigned number that serves as an

10     address for accessing the source packet. Transport packets include a packet identifier (PID). The PID identifies the sequence of transport packets to which a transport packet belongs. Each transport packet in the sequence will have the same PID.

**[0023]**      The CLIPINF directory includes a clip information file

15     associated with each A/V stream file. The clip information file indicates, among other things, the type of A/V stream associated therewith, sequence information, program information and timing information.  The sequence information describes the arrival time basis (ATC) and system time basis (STC) sequences.  For example, the sequence information indicates, among other

20     things, the number of sequences, the beginning and ending time information for each sequence, the address of the first source packet in each sequence and the PID of the transport packets in each sequence. A sequence of source packets in which the contents of a program is constant is called a program

sequence. The program information indicates, among other things, the number of program sequences, the starting address for each program sequence, and the PID(s) of transport packets in a program sequence.

[0024] The timing information is referred to as characteristic

5 point information (CPI). One form of CPI is the entry point (EP) map. The EP map maps a presentation time stamp (e.g., on an arrival time basis (ATC) and/or a system time basis (STC)) to a source packet address (i.e., source packet number). The presentation time stamp (PTS) and the source packet number (SPN) are related to an entry point in the AV stream; namely, the PTS

10 and its related SPN point to an entry point on the AV stream. The packet pointed to is often referred to as the entry point packet.

[0025] The PLAYLIST directory includes one or more playlist files. The concept of a playlist has been introduced to promote ease of editing/assembling clips for playback. A playlist file is a collection of playing

15 intervals in the clips. Each playing interval is referred to as a playitem. The playlist file, among other things, identifies each playitem forming the playlist, and each playitem, among other things, is a pair of IN-point and OUT-point that point to positions on a time axis of the clip (e.g., presentation time stamps on an ATC or STC basis). Expressed another way, the playlist file identifies

20 playitems, each playitem points to a clip or portion thereof and identifies the clip information file associated with the clip. The clip information file is used, among other things, to map the playitems to the clip of source packets.

[0026] The general information files (not shown) provide general

information for managing the reproduction of the A/V streams recorded on the optical disk.

[0027]     In addition to illustrating the data structure of the recording medium according to an embodiment of the present invention, Fig.

5   1 represents the areas of the recording medium.  For example, the general information files are recorded in one or more general information areas, the playlist directory is recorded in one or more playlist directory areas, each playlist in a playlist directory is recorded in one or more playlist areas of the recording medium, etc.  Fig. 2 illustrates an example of a recording medium

10  having the data structure of Fig. 1 stored thereon. As shown, the recording medium includes a file system information area, a data base area and an A/V stream area. The data base area includes a general information file and playlist information area and a clip information area. The general information file and playlist information area have the general information files recorded

15  in a general information file area thereof, and the PLAYLIST directory and playlist files recorded in a playlist information area thereof. The clip information area has the CLIPINFO directory and associated clip information files recorded therein. The A/V stream area has the A/V streams for the various titles recorded therein.

20      [0028]     Video and audio data are typically organized as individual titles; for example, different movies represented by the video and audio data are organized as different titles.  Furthermore, a title may be organized into individual chapters in much the same way a book is often

organized into chapters.

[0029]     Because of the large storage capacity of the newer, high-density recording media such as BD-ROM and BD-RE optical disks, different titles, various versions of a title or portions of a title may be recorded,

5   and therefore, reproduced from the recording media. For example, video data representing different camera angles may be recorded on the recording medium. As another example, versions of title or portions thereof associated with different languages may be recorded on the recording medium. As a still further example, a director's version and a theatrical version of a title may be

10  recorded on the recording medium. Or, an adult version, young adult version and young child version (i.e., different parental control versions) of a title or portions of a title may be recorded on the recording medium. Each version, camera angle, etc. represents a different reproduction path, and the video data in these instances is referred to as multiple reproduction path video data.

15      [0030]     Because of the large storage capacity of the newer, high-density recording media such as BD-ROM still images may be recorded and reproduced in an organized and/or user interactive fashion, for example, as slideshows. The data structure for managing reproduction of still images for a high-density optical disk in accordance with embodiments of the

20  present invention will be described along with methods and apparatuses according to embodiments of the present invention for recording and reproducing still images.

[0031]     Fig. 3 illustrates a method of managing still images for a

high-density recording medium (e.g., high-density optical disk such as a BD-ROM disk) in accordance with one embodiment of the invention. In this embodiment, a part of the data area on, for example, a BD-ROM is reserved exclusively for still images and one or more still images (e.g., MPEG I, JPEG,

5 etc.) are recorded in the still image recording area. Alternatively, a still image recording area is allocated to each of the titles recorded in the data area and still images pertaining to each title are recorded in the associated still image recording area.

[0032]    As illustrated in Fig. 4, the still images (e.g., MPEG I,

10 JPEG, etc.) are stored in a still image file (Still*.tdat) and navigation information associated with the still image file is stored in a still information file (Still*.Info).

[0033]    The still information file includes various information fields such as 'type_indicator', 'version_number', 'length', etc. The

15 'type_indicator' field indicates that the information file is for managing still images and thus indicates that the data in the associated still image file includes data for one or more still images. The 'version_number' field indicates the syntax version of the still information file, and the 'length' field indicates the size of the syntax data, which is the length of the information

20 field subsequent to the 'length' field.

[0034]    If the length is not zero, then the 'number_of_still_images' field indicates the number of still images stored in the still image file associated with the still information file and the

'tn_block_size' field indicates block size of a still image. As shown in Fig. 4, the still information file also includes fields of 'still_image_index', 'image_byte_size', 'horizontal_image_size', and 'vertical_image_size'. The function of each field is indicated in the name of the field, and these fields

5 correspond to each of the still images stored in the still image file.

[0035] When one or more still images are stored in a still image file (Still*.tdat) as mentioned above, each of the still images is stored as a PES (packetized elementary stream) packet defined in the MPEG standards. As shown in Fig. 5, the payload of a PES packet comprises a plurality of

10 source packets, each comprising a 4-byte TP (Transport Packet) extra header and a 188-byte MPEG2 TP.

[0036] The header of the MPEG2 transport packet includes still PID information for indicating that the packet delivers a still image. The still PID is given a value not previously used in standards for the recording

15 medium (e.g., BD-RE for high-density optical disks).

[0037] In the alternative embodiment shown in Fig. 6, still images are stored in separate still image files (Still001.tda, Still002.tdat, ...) and the navigation information associated with the still images is stored in a single still information file (Still*.Info).

20 [0038] The still information file includes the fields of 'type_indicator', 'version_number', 'length', and 'number_of_still_images' mentioned above with reference to the embodiment of Fig. 4. For each still image, the still information file also includes an 'image_file_name' field for

storing the name of each image file as well as the fields of 'still_image_index',

'image_byte_size', 'horizontal_image_size', and 'vertical_image_size'.

[0039]    Fig. 7 illustrates a method of managing still images for a

high-density recording medium according to another embodiment of the

5   invention. In the embodiment shown in Fig. 7, each of the still images is

stored in a still image file (Still001.tda, Still002.tdat, ...) and the navigation

information associated with each of the still images is stored in a still

information file (Still001.Info, Still002.Info, ...). Each of the still information

files includes the fields of 'type_indicator', 'version_number', 'length',

10  'image_byte_size',    'horizontal_image_size'    and    'vertical_image_size'

mentioned above with reference to Fig. 4.

[0040]    Alternative file structures to that of Fig. 1 for effectively

managing still images and still information files will now be described in

detail. Fig. 8 illustrates a file structure of a high-density recording medium

15  in accordance with one embodiment of the invention, wherein a plurality of

still images are stored in a still image file (still.tdat) and navigation

information for the still images is also stored in a still information file

(still.info) as described before. The still image file and still information file

can be placed in the root directory, for example, 'BD'.

20      [0041]    The root directory 'BD' contains a plurality of title

directories (TITLE001, TITLE002, ...) and each of the title directories contain

subdirectories such as PLAYLIST, CLIPINF, and STREAM.

[0042]    In a file structure shown in Fig. 9, both the still image

file and the still information file are placed in the root directory 'BD' and TITLE, PLAYLIST, CLIPINF, and STREAM directories are placed in the root directory 'BD' as well.

[0043]    In a file structure shown in Fig. 10, both the still image

5   file and the still information file are placed in the STILL directory, which is a subdirectory of the root directory 'BD'. The root directory further contains a plurality of title directories (TITLE001, TITLE002, ...) each of which contains PLAYLIST, CLIPIINF, and STREAM directories.

[0044]    In a file structure shown in Fig. 11, both the still image

10  file and the still information file are stored in the STILL directory, which is a subdirectory the root directory 'BD'. The root directory further contains TITLExxx, PLAYLIST, CLIPINF, and STREAM directories.

[0045]    While the above-described embodiments have shown a single still image file and single still information file, it should be understood

15  that the present invention is not limited to this file structure. Instead, a separate still image file may be provided for each still image or a subset of still images and/or a separate still information file may be provided for each still image or subset of still images. Alternatively, some combination of these embodiment may be provided.

20      [0046]    Fig. 12 illustrates a method of managing still images in accordance with another embodiment of the invention, wherein still images are intermittently inserted into each title, which includes movie video data or audio data. As shown, the title is recorded in the data area of a BD-ROM.

**[0047]**     A still image (e.g., MPEG I, JPEG, etc.) recorded with movie video data in each title is stored as a PES (packetized elementary stream) packet. The header of a PES packet contains unique stream ID information for indicating that the data contained in the payload is a still

5  image and a PTS (presentation time stamp) indicative of the display timing of the still image.

**[0048]**     The payload of a PES packet comprises a plurality of source packets, each comprising a 4-byte TP (transport packet) extra header and a 188-byte MPEG2 TP (transport packet). The TP extra header comprises

10 2-bit copy information and 30-bit still information or packet arrival time stamp. In the case where the source packet corresponds to a still image, still information such as 'image start/end flag' is used instead of the packet arrival time stamp.

**[0049]**     The header of an MPEG2 TP packet contains a still PID,

15 which is given a value not previously used in the recording medium standard of interest, for example, '0x1023' in BD-RE. In an embodiment shown in Fig. 13, the first source packet among source packets carrying a plurality of still images has the still information such as the image start/end and image size for the still images

20      **[0050]**     In an embodiment shown in Fig. 14, the first source packet among source packets carrying a still image has still information such as the image start/end and image size for the still image. As shown in Fig. 15, the still information contains the fields of 'still_start_end_flag',

'image_start_end_flag', 'number_of_images', 'display_info', 'image_info', 'image_data_size', etc.

[0051]    For example, if the 'still_start_end_flag' field is '0', it indicates the still image start position. If the field is '1', it indicates that the

5  still image end position. The 'number_of_images' field indicates the number of still images to be displayed.

[0052]    The 'image_info' field indicates the attributes of the still image to be displayed and the display properties. The 'display_info' field indicates the display timing, display sequence, display effect, and the display

10 effect period of the still image. The 'image_data_size' indicates the size of the still image.

[0053]    In an embodiment shown in Fig. 16, the still information is contained in the TP extra packet of the first source packet (Source Packet #1). The TP extra packet of the other source packets contains information

15 other than the still information.

[0054]    In an embodiment shown in Fig. 17, instead of storing the still information in source packets, still display start information and still image start information are stored in playlist information and such information is associated with corresponding source packets.

20    [0055]    An optical disk reproducing apparatus outputs movie data and still images or audio data and still images to, for example, a connected television set by referring to navigation information according to the present invention such as still information file. Fig. 18 illustrates a

schematic diagram of an embodiment of an optical disk recording and reproducing apparatus according to the present invention. As shown, an AV encoder 9 receives and encodes data (e.g., movie video and audio data, only audio data, and/or still image data). The AV encoder 9 outputs the encoded

5   data along with coding information and stream attribute information. A multiplexer 8 multiplexes the encoded data based on the coding information and stream attribute information to create, for example, an MPEG-2 transport stream. A source packetizer 7 packetizes the transport packets from the multiplexer 8 into source packets in accordance with the audio/video format

10  of the optical disk. As shown in Fig. 18, the operations of the AV encoder 9, the multiplexer 8 and the source packetizer 7 are controlled by a controller 10. The controller 10 receives user input on the recording operation, and provides control information to AV encoder 9, multiplexer 8 and the source packetizer 7. For example, the controller 10 instructs the AV encoder 9 on the type of

15  encoding to perform, instructs the multiplexer 8 on the transport stream to create, and instructs the source packetizer 7 on the source packet format. The controller 10 further controls a drive 3 to record the output from the source packetizer 7 on the optical disk.

**[0056]**      The controller 10 also creates the navigation and

20  management information for managing reproduction of the data being recorded on the optical disk. For example, based on information received via the user interface (e.g., instruction set saved on disk, provided over an intranet or internet by a computer system, etc.) the controller 10 controls the

drive 3 to record one or more of the data structures of Figs. 1-17 on the optical disk.

[0057] During reproduction, the controller 10 controls the drive 3 to reproduce this data structure. Based on the information contained 5 therein, as well as user input received over the user interface (e.g., control buttons on the recording and reproducing apparatus or a remote associated with the apparatus), the controller 10 controls the drive 3 to reproduce the data from the optical disk. For example, as discussed above with respect to the embodiments of the present invention, a still image or still images may be 10 reproduced based on the navigation information provided in a still information file.

[0058] The reproduced source packets are received by a source depacketizer 4 and converted into a data stream (e.g., an MPEG-2 transport packet stream). A demultiplexer 5 demultiplexes the data stream into encoded 15 data. An AV decoder 6 decodes the encoded data to produce the original data that was feed to the AV encoder 9. During reproduction, the controller 10 controls the operation of the source depacketizer 4, demultiplexer 5 and AV decoder 6. The controller 10 receives user input on the reproducing operation, and provides control information to AV decoder 6, demultiplexer 5 and the 20 source packetizer 4. For example, the controller 10 instructs the AV decoder 9 on the type of decoding to perform, instructs the demultiplexer 5 on the transport stream to demultiplex, and instructs the source depacketizer 4 on the source packet format.

**[0059]** While Fig. 18 has been described as a recording and reproducing apparatus, it will be understood that only a recording or only a reproducing apparatus may be provided using those portions of Fig. 18 providing the recording or reproducing function.

5 **[0060]** In FIG. 19, the apparatus reads still images intermittently recorded in each title with movie video and audio and stores the still images in a temporary buffer. Then, the apparatus performs still operations using the still information recorded in various ways as described above.

10 **[0061]** In Fig. 20, the optical disk reproducing apparatus reads still images with movie video and audio recorded in each title and stores the still images in an internal temporary buffer of the VDP system . Then, the apparatus performs still operations by synchronizing the timings of still images and video or audio data using the display time of still images and 15 presentation time of video or audio data.

**[0062]** As will be appreciated from the forgoing disclosure, the present invention provides a recording medium having a data structure for managing still images recorded on a high-density recording medium (e.g., a high-density optical disk such as a BD-ROM). For example, the data 20 structure allows for displaying movie video and still images or audio and still images in various ways.

**[0063]** As apparent from the above description, the present invention provides methods and apparatuses for recording a data structure

on a high density recording medium for managing still images recorded on the recording medium.

[0064]    While the invention has been disclosed with respect to a limited number of embodiments, those skilled in the art, having the benefit of

5   this disclosure, will appreciate numerous modifications and variations there from. For example, while described with respect to a Blu-ray ROM optical disk in several instances, the present invention is not limited to this standard of optical disk or to optical disks. It is intended that all such modifications and variations fall within the spirit and scope of the invention.